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BIOLOGY
HIGHER LEVEL
PAPER 2

Monday 17 May 2010 (afternoon)

2 hours 15 minutes

Candidate session number

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INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided.
- Section B: answer two questions from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

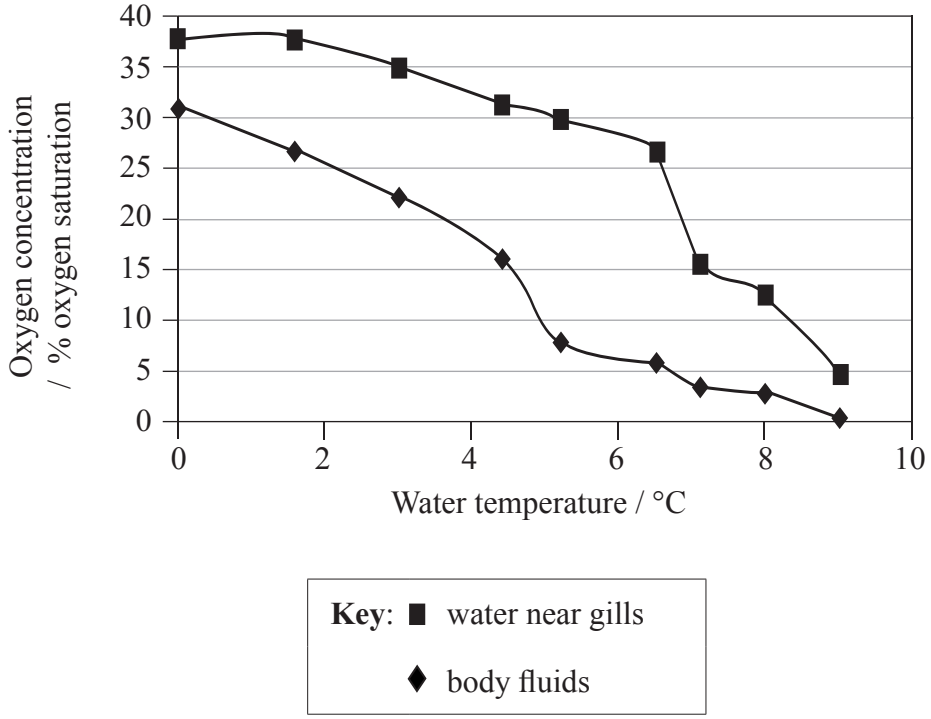
0110

SECTION A

*Answer **all** the questions in the spaces provided.*

1. During aerobic cell respiration, oxygen is consumed and carbon dioxide is produced inside cells. This generates concentration gradients between respiring cells and the environment, which cause diffusion of oxygen and carbon dioxide. Both oxygen and carbon dioxide are soluble in water. As the temperature rises, water becomes saturated at a lower concentration of the gas.

Laternula elliptica is a mollusc that lives on the sea bed in Antarctica. Its body temperature is always similar to that of the environment around it. To investigate the effect of temperature on *Laternula elliptica*, specimens were kept in temperature-controlled aquaria. The oxygen concentrations of water near the gills and in the body fluids were measured, at a range of temperatures from 0 °C to 9 °C. The graph below shows the mean results.



[Source: Hans O Pörtner, Lloyd S Peck and Timo Hirse, "Hyperoxia alleviates thermal stress in the Antarctic bivalve, Laternula elliptica: evidence for oxygen limited thermal tolerance", *Polar Biology*, 2006, **29** (8), pages 688– 693]

(This question continues on the following page)

(Question 1 continued)

(a) (i) Outline the relationship between temperature and oxygen concentration in the body fluids in *Laternula elliptica*. *[2]*

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(ii) Suggest **two** reasons for the relationship. *[2]*

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(b) In its natural environment, *Laternula elliptica* buries itself in the mud on the sea bed. In this investigation, it was found that above 6 °C it is unable to bury itself. Suggest a reason for this. *[1]*

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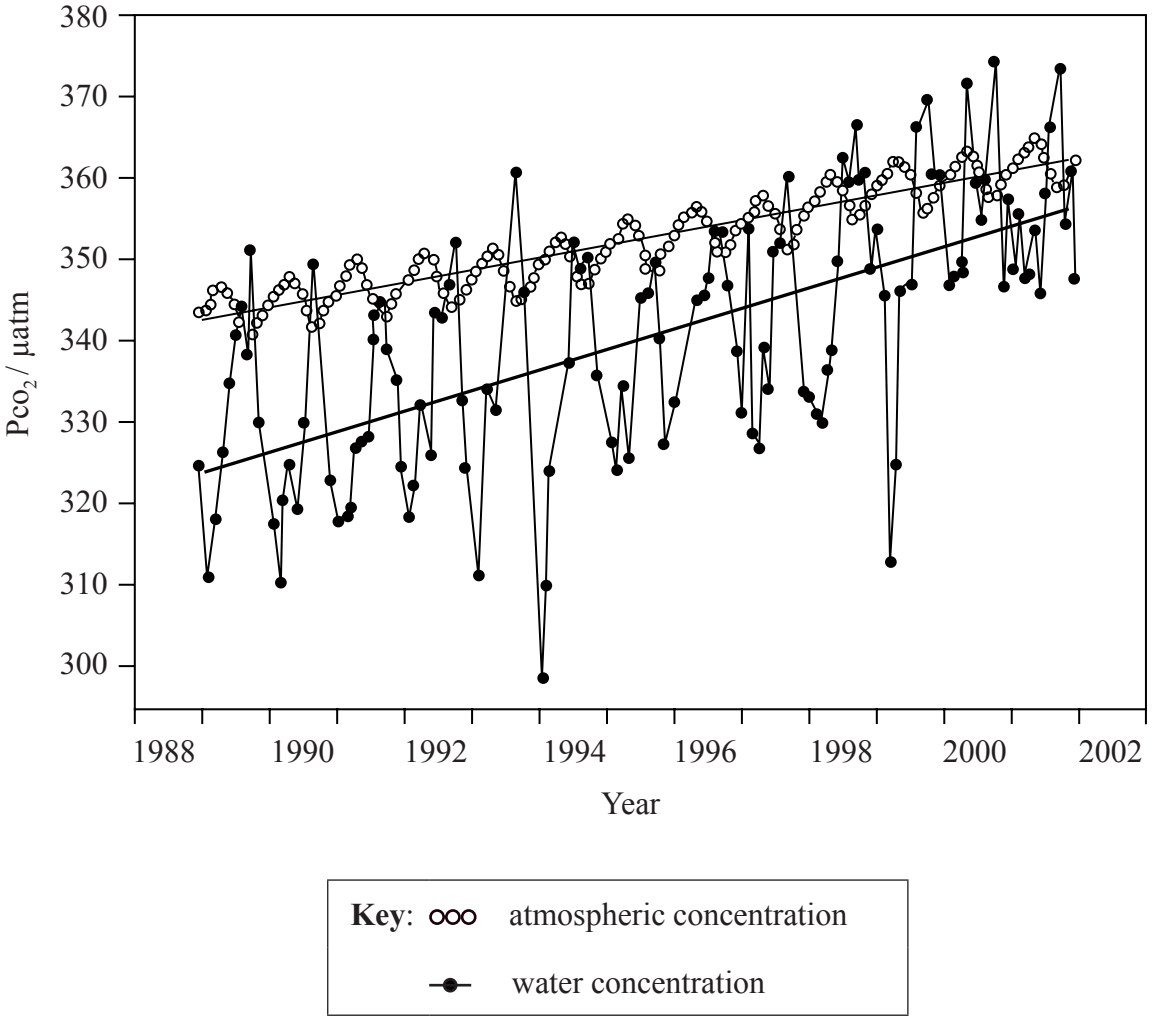
(Question 1 continued)

The world's oceans can absorb large amounts of carbon dioxide. This process has been studied in the Pacific Ocean near Hawaii, by measuring carbon dioxide concentrations in the atmosphere and in surface water every month, from October 1988 onwards. The graph below shows the carbon dioxide concentration expressed as partial pressures (Pco_2).



[Reprinted by permission from Macmillan Publishers Ltd: *Nature*, Dore, *et al.*, "Climate-driven changes to the atmosphere CO2 sink in the subtropical North Pacific Ocean", 424, pages 754-757, copyright 2003.]

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(Question 1 continued)

(c) (i) Describe the trends in atmospheric carbon dioxide concentration, shown in the graph. *[2]*

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(ii) Suggest **two** reasons for the trends that you have described. *[2]*

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(d) (i) Diffusion of carbon dioxide only occurs when there is a concentration gradient. Deduce the pattern of carbon dioxide diffusion, between water and atmosphere, from 1988 to 2002. *[2]*

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(ii) The graph provides evidence for the hypothesis that there will be no net diffusion of carbon dioxide between water and atmosphere by 2020. Explain this evidence. *[1]*

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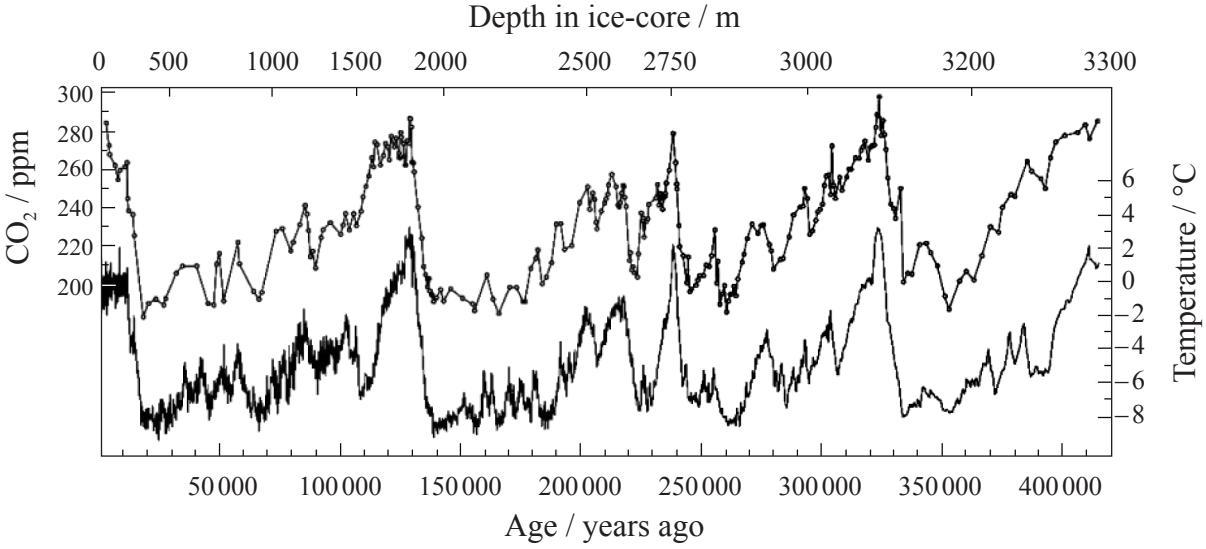
(Question 1 continued)

The concentration of carbon dioxide in the atmosphere is currently 385 ppm (parts per million). Variations in the concentration of carbon dioxide in the atmosphere can be studied using ice-cores. An ice-core record covering the last 400 000 years has been obtained from Vostok in the Antarctic. The graph below shows the carbon dioxide concentrations that were measured at different depths in the ice. Atmospheric temperatures are also shown on the graph. These were deduced from ratios of oxygen isotopes. The upper line on the graph shows CO_2 concentrations and the lower line shows temperature.



[Reprinted by permission from Macmillan Publishers Ltd: *Nature*, Lee R. Kump, "Reducing uncertainty about carbon dioxide as a climate driver", 419, pages 188-190, copyright 2002.]

(e) (i) State the highest carbon dioxide concentration shown on the graph. *[1]*

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(ii) State the highest temperature shown on the graph. *[1]*

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(f) Using the data in the graph, deduce the relationship between atmospheric carbon dioxide concentration and temperature. *[1]*

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(g) Using the data in this question, explain reasons for concern about the long-term survival of Antarctic species, such as *Laternula elliptica*. *[3]*

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2. (a) Glucose and galactose are examples of monosaccharides. State **one** other example of a monosaccharide. *[1]*

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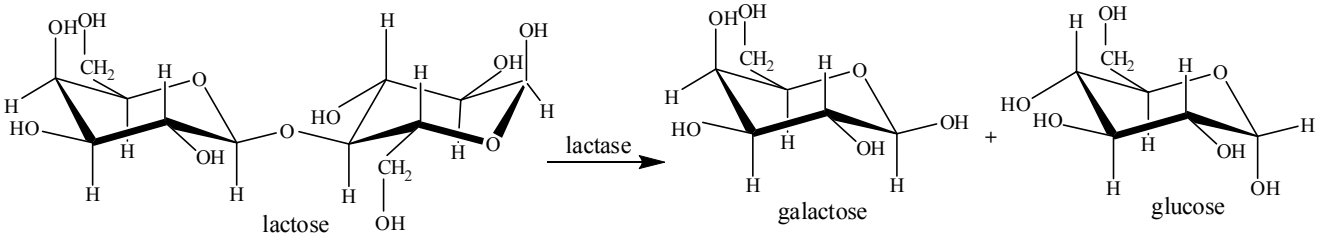
(b) The equation below shows the production of glucose and galactose from lactose.



(i) There are several different types of carbohydrate. State which type of carbohydrate lactose is. *[1]*

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(ii) State the type of chemical reaction that occurs when lactose is digested into glucose and galactose. *[1]*

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(c) Lactase is widely used in food processing. Explain **three** reasons for converting lactose to glucose and galactose during food processing. *[3]*

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3. . . . . .

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(d) Simple laboratory experiments show that when the enzyme lactase is mixed with lactose, the initial rate of reaction is highest at 48 °C. In food processing, lactase is used at a much lower temperature, often at 5 °C. Suggest reasons for using lactase at relatively low temperatures. *[2]*

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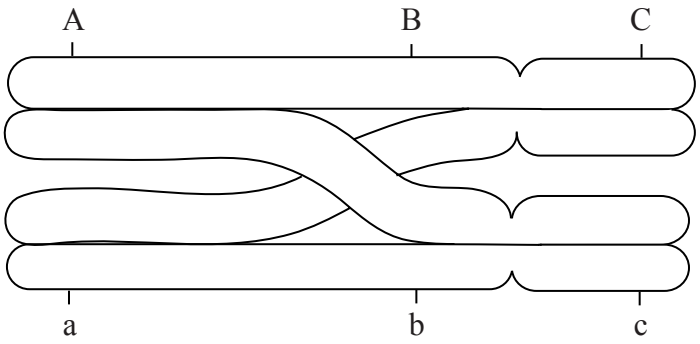
3. The diagram below shows a pair of chromosomes during meiosis in a cell in the human testis. The position of the alleles of some genes is indicated.



(a) Deduce, with reasons for your answer, whether the chromosomes are

(i) autosomes or sex chromosomes. *[1]*

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(ii) homologous or non-homologous. *[1]*

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(b) State the stage of meiosis of a cell if it contains pairs of chromosomes as shown in the diagram. *[1]*

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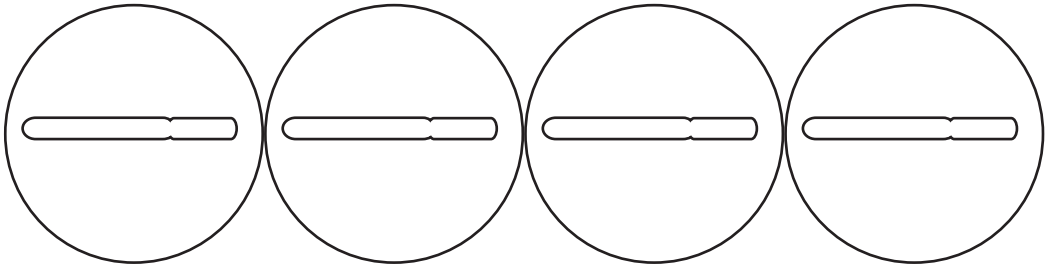
(This question continues on the following page)

(Question 3 continued)

(c) At the end of meiosis, each of the chromatids shown in the diagram will be in a different haploid cell. The diagrams below represent the chromatids inside the haploid cells. Determine the combinations of alleles that would be present on each chromatid. Use the diagrams to indicate your answer. *[2]*



(d) State the pattern of inheritance shown by the three genes. *[1]*

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SECTION B

*Answer **two** questions. Up to two additional marks are available for the construction of your answers. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

4. (a) Blood is a liquid tissue containing glucose, urea, plasma proteins and other components. List the other components of blood. *[5]*

(b) Outline how the human body prevents blood glucose concentration from rising excessively. *[5]*

(c) Blood plasma, glomerular filtrate and urine have different concentrations of solutes, such as glucose, protein and urea. Explain the processes occurring in the kidney that cause differences in the concentrations of these solutes between blood plasma, glomerular filtrate and urine. *[8]*

5. (a) The main parts of growing plants are roots, stems and leaves. Draw a plan diagram to show the arrangement of tissues in the stem of a dicotyledonous plant. *[5]*

(b) Outline the adaptations of plant roots for absorption of mineral ions from the soil. *[5]*

(c) Photosynthesis and transpiration occur in leaves. Explain how temperature affects these processes. *[8]*

6. (a) Eukaryotic cells have intracellular and extracellular components. State the functions of **one named** extracellular component. *[4]*

(b) Outline, with an example, the process of exocytosis. *[5]*

(c) Translation occurs in living cells. Explain how translation is carried out, from the initiation stage onwards. *[9]*

7. (a) Most of the DNA of a human cell is contained in the nucleus. Distinguish between unique and highly repetitive sequences in nuclear DNA. *[5]*

(b) Draw a labelled diagram to show **four** DNA nucleotides, each with a different base, linked together in **two** strands. *[5]*

(c) Explain the methods and aims of DNA profiling. *[8]*